

A NEW DWARF CRAYFISH FROM THE PACIFIC VERSANT OF MEXICO (DECAPODA: CAMBARIDAE)

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Abstract.—*Cambarellus proluxus* is described from Lago de Chapala, in the State of Jalisco, Mexico. It shares the lake with two of its closest relatives, *Cambarellus chapalanus* (Faxon) and *C. montezumae* (Saussure), but appears to occupy a different niche. The new species may be distinguished from all other members of the genus by the length of the acumen, which is at least 0.8 as long as, and usually greater in length than, the remainder of the rostrum.

Introduction

The new crayfish described herein was discovered during the course of studies on Lago de Chapala, State of Jalisco, conducted by the Instituto de Ingeniería of the Universidad Nacional Autónoma de México. Among the organisms collected in the vicinity of Ajijic were several specimens of a crayfish (acocil) of the genus *Cambarellus* which were readily recognized as being different from *Cambarellus chapalanus* (Faxon, 1898:661), the common crayfish inhabiting much of the littoral zone of the lake. In subsequent collecting efforts, one of us (AV-F) obtained numerous specimens of this unique crayfish, verifying its restricted habitat and limited distribution within the lake.

Cambarellus proluxus, new species

Figs. 1, 2

Diagnosis.—Pigmented, eyes well developed. Rostrum with margins subparallel to concave and bearing spines, acumen at least 0.8 as long as basal part. Carapace without cervical spine. Areola 3.0 to 4.8 (average 3.7) times as long as broad and constituting 22.6 to 27.7 (average 26.1) percent of total length of carapace (39.0 to 48.2, average 44.2, percent of postorbital carapace length). Suborbital angle broadly obtuse to subacute. Branchiostegal spine absent. Postorbital ridge with acute cephalic extremity, spine often overreaching posterior margin of orbit. Antennal scale approximately 3 times as long as wide, broadest proximal to midlength. Merus of cheliped with 0-2 dorsal, 1-3 ventral, and 1 distolateral spines. Hooks on ischia of second and third pereopods of male, form I, simple, neither overreaching basioischial articulation nor opposed by tubercle on corresponding basis; coxa of fourth pereopod with well developed cephalomesial and caudomesial bosses, that of fifth pereopod subtuberculiform. First pleopods of first

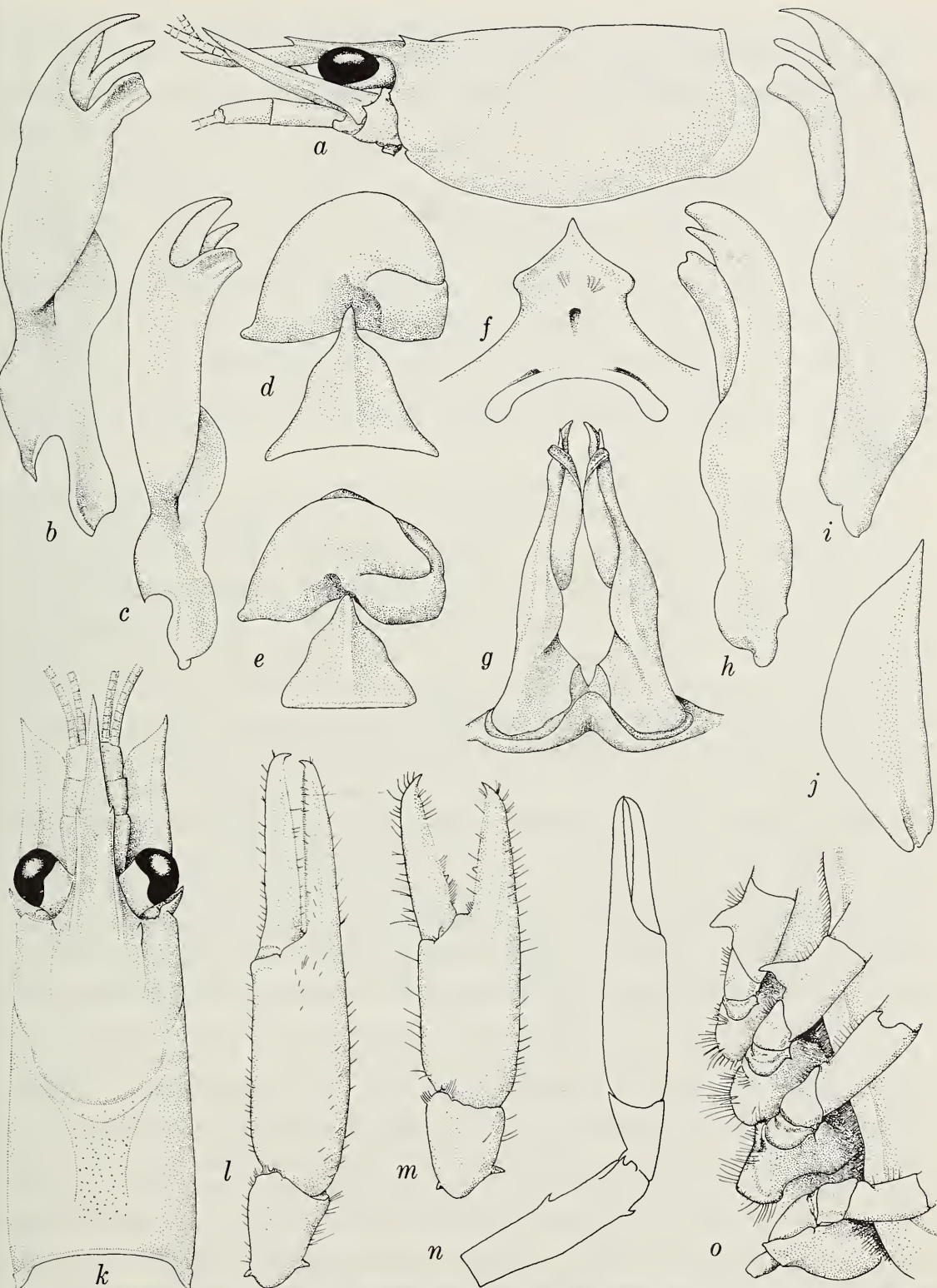


Fig. 1. *Cambarellus prolixus* (all illustrations are of holotype except *c* and *h* of morphotype, *d*, *e*, and *m* of allotype, and *g* of paratypic male, form I): *a*, Lateral view of carapace; *b*, *c*, Mesial view of first pleopod; *d*, *e*, Annulus ventralis; *f*, Epistome; *g*, Caudal view of first pleopods; *h*, *i*, Lateral view of first pleopod; *j*, Antennal scale; *k*, Dorsal view of carapace; *l*, *m*, Dorsal view of distal podomeres of right cheliped; *n*, Lateral view of distal podomeres of left cheliped; *o*, Proximal podomeres of second through fifth pereiopods.

form male symmetrical, very weakly arched at distal end of proximal third, lacking both subapical setae and shoulder on cephalic surface; terminal elements corneous, subparallel in lateral aspect, and directed at about 40 degree angle to main shaft of appendage: mesial process with troughlike groove mesially, truncate distally, and directed somewhat distolaterally; central projection tapering from base, its apical part slightly inclined mesially; and slender caudal process extending caudodistally beyond other 2 elements. Annulus ventralis about 1.5 times as broad as long, caudal face with conspicuous median concavity at base receiving postannular sclerite when annulus rotated posteriorly; prominent undulating horizontal sinus cutting sinistral anterior, lateral, and caudal surfaces. Postannular sclerite campanulate in outline, 1.2 to 1.3 times as broad as long, and base more than 0.75 times as broad as greatest width of annulus ventralis. First pleopod lacking in female.

Holotypic male, form I.—Cephalothorax (Fig. 1a, k) subovate, slightly compressed. Greatest width of carapace little more than height at caudo-dorsal margin of cervical groove. Areola about 3.0 times as long as wide with 5 or 6 punctations across narrowest section, its length constituting 26.1 percent of entire length of carapace (43.4 percent of postorbital carapace length). Surface of carapace weakly punctate, many punctations bearing simple setae. Rostrum with slender lateral carinae weakly concave laterally and terminating in well developed spines overreaching basal segment of antennule; acumen conspicuously long, overreaching antennal scale, and extending beyond antennular peduncle by distance subequal to length of ultimate podomere of latter; dorsal surface concave with usual submarginal rows of setiferous punctations and scattered ones between. Subrostral ridges rather weak but evident in dorsal aspect along almost basal third of rostrum. Left suborbital angle well defined and, although forming obtuse angle, with small slightly eccentric subacute apex; angle on right side injured. Brachiostegeal spine lacking, cephalic extremity of branchiostegite rounded. Cervical spine absent.

Abdomen slightly narrower than carapace (5.1 and 5.5 mm). Pleura of third through fifth segments truncate ventrally and lacking angles. Cephalic section of telson with 1 spine in each caudolateral corner. Cephalic lobe of epistome (Fig. 1f) broadly joined to main body, subtriangular, apex of anterior angle produced; main body with distinct fovea; epistomal zygoma rather strongly arched. Proximal podomere of antennule with conspicuous spine on ventromesial border at about midlength. Antennal peduncle with well developed spine on distolateral surface of basis; ischium with small ventral tubercle; flagellum extending caudally to almost midlength of telson. Antennal scale (Fig. 1j) 7.4 times as long as broad, widest proximal to midlength; mesial margin of lamellar area with 2 subangular bends, proximal one at widest part of scale and other at about base of distal fourth; disto-

Table 1.—Measurements (mm) of *Cambarellus prolixus*.

	Holotype	Allotype	Morphotype
Carapace:			
Entire length	16.1	14.2	16.9
Postorbital length	9.7	9.0	9.3
Width	5.5	5.5	5.5
Height	5.3	5.6	4.9
Areola:			
Width	1.4	1.1	1.1
Length	4.2	3.9	4.3
Rostrum:			
Width	1.8	1.8	1.7
Length	7.0	5.6	8.3
Length of acumen	3.7	2.5	5.2
Chela:			
Length, palm mesial margin	5.6	3.8	4.0
Palm width	2.8	2.6	2.0
Length, lateral margin	11.3	8.0	9.1
Dactyl length	5.1	4.0	4.7
Abdomen:			
Width	5.1	5.7	5.2
Length	16.8	14.5	16.0

lateral spine overreaching antennular peduncle but falling short of apex of acumen.

Third maxilliped extending cephalically to slightly beyond basal segment of antennular peduncle; mesial half of ischium with broad band of stiff simple setae, single row of plumose setae flanking ventromesial side of lateral costa, and few between row and mesial band, distolateral angle not produced; exopod reaching midlength of propodus.

Right chela (Fig. 1l) subovate in cross-section, not strongly depressed; surface, except for opposable margins of fingers, lacking tubercles and spines but studded with setiferous punctations, those with short setae much more numerous than those with long ones; latter more abundant along lateral surface of fixed finger, on mesial surface and flanking low submedian longitudinal ridge on dorsal surface of dactyl, and along opposable margins of both fingers. Opposable margin of both fingers with band of minute denticles extending along almost entire length; in addition, fixed finger with tubercle near base, and dactyl with corneous cusp slightly beyond distal end of basal third of finger (in dorsal aspect, tubercles hidden by minute denticles).

Carpus of cheliped about 1.3 times as long as broad, bearing setiferous punctations; distal ventrolateral articular area produced in strong acute

spine. Merus of cheliped (Fig. 1n) likewise with setiferous punctations, longest setae ventrally and proximolaterally, those situated on latter forming row of 6 conspicuously long ones; dorsal margin with strong preterminal spine, ventral surface with 1 at about midlength, and lateral surface with 1 at distal extremity. Ischium also with setiferous punctations, but without spines or tubercles; sufflamen clearly defined.

Hooks on ischia of second and third pereiopods (Fig. 1o) simple, not overreaching basioischial articulation and not opposed by tubercle on corresponding basis; that on third more tapering and clawlike. Coxa of fourth pereiopod with conspicuous setiferous caudomesial and cephalomesial bosses, latter directly cephalolaterally; coxa of fifth pereiopod with less conspicuous tuberculiform caudomesial boss bearing few setae. Sternum between second, third, and fourth pereiopods rather deep; lateral margins not strongly produced ventrally but setae borne on them conspicuous.

First pleopods (Fig. 1b, g, i) as described in "Diagnosis." Lateral lobe of proximal podomere of uropod broadly rounded, mesial lobe with distinct spine; distomedian spine on mesial ramus premarginal.

Allotypic female.—Differing, other than in secondary sexual features, from holotypic male in following respects: rostral margins subparallel to level of marginal spines, latter more divergent than in holotype, acumen distinctly shorter, not overreaching antennal scale, dorsal surface with number of long setae between submarginal rows; in dorsal aspect, subrostral ridges disappearing beneath lateral carinae on basal fourth of rostrum; suborbital angle lacking subacute apex; abdomen slightly broader than carapace (5.7 and 5.5 mm); cephalic section of telson with 2 spines in each caudolateral corner; cephalic lobe of epistome triangular, cephalic angle not produced; mesial borders of antennal scale rounded, 2 subangular bends not so evident (Fig. 2i), distolateral spines reaching level of apex of acumen; both fingers of chela (Fig. 1m) with tuft of setae at ventral opposable base, opposable margin of fixed finger with tooth at end of proximal third, dactyl with 2 teeth in corresponding position, minute denticles arranged in single row on both fingers. See Table 1 for differences in proportions of chelae and other body regions.

Annulus ventralis (Fig. 1e) as described in "Diagnosis." First pleopods absent. Basal podomere of uropod as in holotype.

Morphotypic male, form II.—Differing from holotype in following respects: section of rostrum posterior to marginal spines shorter than in holotype, acumen overreaching antennular peduncle by almost 3 times length of ultimate podomere of latter, setae on dorsal surface less numerous than in holotype; cephalic section of telson with 2 spines in each caudolateral corner; epistome triangular, cephalic angle not produced; tubercle on ischium of antenna acute; flagellum of antenna overreaching caudal margin of telson; antennal scale with mesial margin of lamella more rounded, sub-

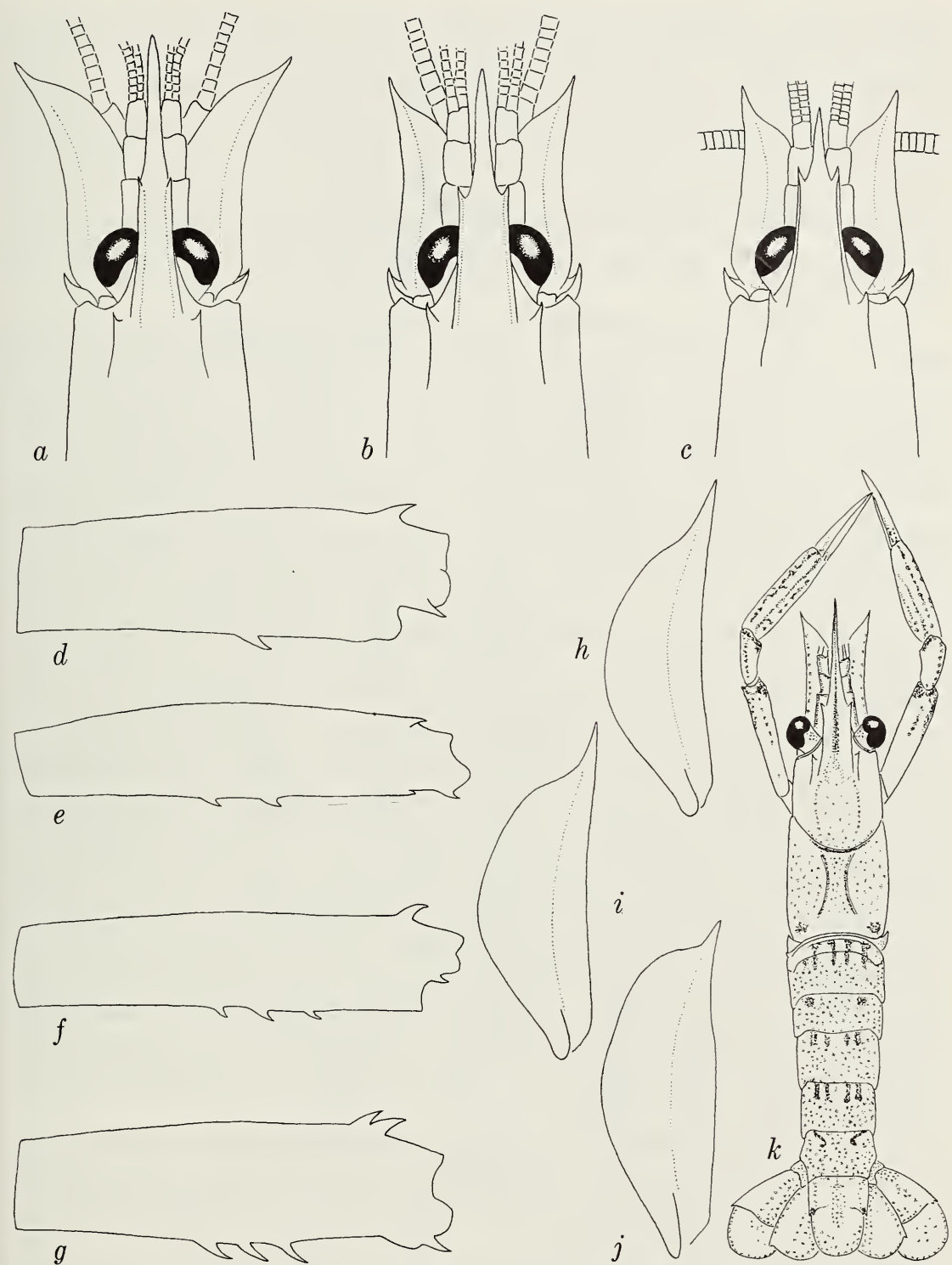


Fig. 2. *Cambarellus prolixus*: a-c, Dorsal view of cephalic region of paratypic males, form I; d-g, Lateral view of right merus of paratypic males, form I; h, j, Dorsal view of right antennal scale of paratypic males, form I; i, Same of allotype; k, Diagrammatic representation of color pattern. Note: Acumen probably regenerated in c.

angular bends obscured; third maxilliped extending cephalically to base of ultimate podopere of antennule; opposable margin of fixed finger of chela lacking tooth, that of dactyl situated on proximal tenth of finger; hooks on ischia of second and third pereopods much reduced in size and that on third tuberculiform rather than clawlike; cephalomesial boss on fourth pereopod represented by ridge and not so well defined; first pleopod (Fig. 1c, h) less inclined caudally, caudal process and central projection disposed as in holotype but shorter and more robust, mesial process also shorter, and none of 3 corneous.

Color notes.—The general coloration of this crayfish is grayish brown, pale to translucent in areas where the chromatophores are widespread or absent, and dark where they occur in clusters (Fig. 2k). Almost all of the markings are bilaterally distributed except for the median line on the rostrum and the broader median cluster on the telson. The dorsomedian line on the rostrum extends from the apex caudally beyond the base of the orbit. Paired, laterally convex lines mark the gastric region, and subparallel ones flank the dorsal part of the cervical groove, that posterior to the groove being darker than that anterior to it. Concave lines abut the mesial margins of the branchiocardiac grooves, and a pair of conspicuous splotches are present near the dorsal posterolateral borders of the carapace. Two pairs of short, longitudinal, darker markings occur on either side of the median line of the terga of the first and second abdominal segments. The chromatophores on the third abdominal tergum are, for the most part, rather evenly distributed but a pair of subcircular spots are present anterolaterally. On the fourth and fifth terga there are repetitions of the pattern on the first and second, and the sixth tergum exhibits an anterior dorsolateral pair of curved markings. The most conspicuous elements of the color pattern on the telson are the dark clusters at the caudolateral extremities of the cephalic section; the general distribution of the chromatophores on the remainder of the telson and uropods is as illustrated. Color on the first pereopods is concentrated toward the dorsodistal end of the merus, along the dorsomesial distal part of the carpus, on and flanking the mesial surface of the propodus, and on the proximal part of the fingers.

Size.—The largest specimen available is a female having a carapace length of 17.2 (postorbital carapace length 9.8) mm. Corresponding lengths of the smallest first form male are 9.9 (6.0) mm, and of the smaller of the two ovigerous females 11.9 (7.3) mm.

Type-locality.—Lago de Chapala (Fig. 3), 500 meters from the north levee at Ajijic, State of Jalisco, Mexico, at depths of 4 to 5 meters. (See "Ecological Notes.")

Disposition of types.—The holotypic male, form I, allotypic female, and morphotypic male, form II, are deposited in the National Museum of Natural History, Smithsonian Institution, nos. 177206, 177207, and 177208, re-

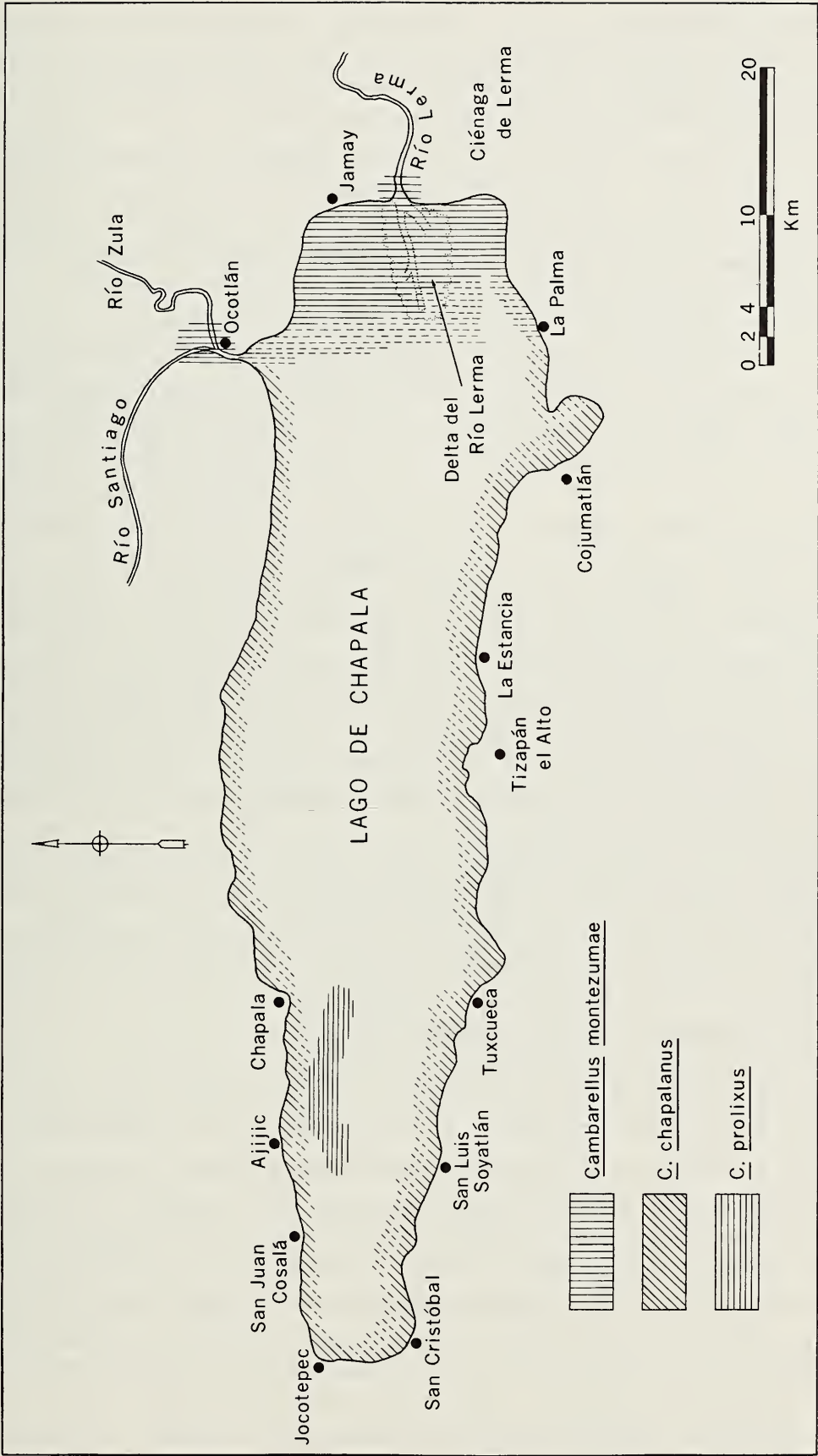


Fig. 3. Lago de Chapala, depicting the distribution of the three crayfishes inhabiting the lake.

spectively. Of the paratypes, 2 ♂ I, 2 ♂ II, and 2 ♀ are deposited in each of the following: Texas Memorial Museum, University of Texas at Austin; British Museum (Natural History); and Rijksmuseum van Natuurlijke Historie. Of the remaining paratypes, 57 ♂ I, 41 ♂ II, 45 ♀, 19 j♂, 15 j♀, 2 ovig ♀, and 1 ♀ with young are deposited in the National Museum of Natural History and 25 ♂ I, 24 ♂ II, 27 ♀, 45 j♂, 36 j♀ in the Instituto de Biología, Universidad Nacional Autónoma de México. All except one of the first form males were collected by the first author and M. E. Zamora on 20 November 1977; the single male was obtained by C. D. Barbour on 9 December 1979.

Range.—Known only from Lago de Chapala, Jalisco, Mexico.

Variations.—The greatest range of variation noted occurs in the shape of the rostrum and relative length of the acumen (Fig. 2a–c); the margins may be subparallel, slightly convergent, or concave, and the acumen ranges in length from 0.8 to 1.9 times as long as the basal part of the rostrum. Perhaps most of those rostra in which the acumen is shorter than the basal section have been injured. The shape of the antennal scale is also variable (Fig. 12h–j), the lateral margin may be almost straight or bowed mesially or laterally; the mesial margin of the lamellate area may exhibit two subangular bends or be gently rounded in an almost continuous curve. The teeth on the opposable margins of the fingers of the chelae may vary from 0 to 2 and be positioned at different levels along the proximal third of the finger. On the merus of the cheliped (Fig. 2d–g) there may be none to two well developed premarginal spines dorsally and one to three ventrally. The cephalic section of the telson bears one or two spines in each caudolateral corner. For other variations see Table 1 and “Diagnosis.”

Ecological notes.—Lago de Chapala forms a part of the basin of the Río Lerma and Río Santiago which drain some 130,000 km². It is the largest lake in Mexico, having an area of 1100 km², and, in addition to receiving the waters of the two rivers, it is also fed by runoff from lakeside dwellings, municipalities, farms, and industries; consequently evidence of eutrophication and contamination is almost always present.

Prior to the discovery of *Cambarellus proluxus*, *C. chapalanus* was the only crayfish known to occur in the lake (the presence of a third species, *C. montezumae* (Saussure, 1857:102), at the eastern end was disclosed during the study mentioned in the introductory paragraph above). As shown on the accompanying map, all three species frequent the marginal or submarginal zone of this body of water; however, *C. proluxus* does not share the littoral biotope, but lives at depths of three or four meters where the bottom is littered with plant debris; some individuals invade depths of seven or eight meters. The temperature at these depths varies between 18 and 20.5°C; the pH exhibits values of 8.3 to 8.6; the transparency ranges from 1.2 to 1.4 m; and the oxygen concentration varies from 4.44 to 4.66 ml/l.

Among the animal components of the biocenosis to which *C. proluxus*

belongs are *Anodonta* sp. and *Pisidium* sp. (bivalve mollusks belonging to the families Unionidae and Sphaeridae, respectively), *Planorbis* sp. (snails of the family Planorbidae), larvae and nymphs of various insects including members of the orders Odonata (Zygoptera and Anisoptera), Hemiptera, Trichoptera, and Coleoptera (Dytiscidae).

Life history notes.—First form males have been collected on November 20 and December 9. On the former date, two ovigerous females and another carrying second instar young were obtained. One of the ovigerous females had a carapace length of 14.6 (postorbital carapace length 9.1) mm and carried 70 eggs with diameters ranging from 0.8 to 0.9 mm. Corresponding measurements of the other were 11.9 (7.3) mm and her brood of eggs consisted of 54 with diameters of 0.9 to 1.0 mm. Twenty-one young were found on a female with lengths of 14.2 (8.4) mm. Inasmuch as the young were in the second instar, many or a few could have escaped prior to or during capture and preservation.

Relationships.—*Cambarellus prolixus* is without doubt more closely allied to the other Mexican members of the genus than to any of those species occurring in the United States, and shares as much in common with *C. chapalanus*, a species described from the same lake, as with any other member of the genus. The most striking similarities are in the spination, the first pleopod of the male, and in the annulus ventralis of the female. More distantly related are *C. montezumae*, *C. patzcuarensis* Villalobos (1943:607), and *C. zempoalensis* Villalobos (1943:601). It may be distinguished most readily from all other members of the genus in possessing an acumen that is no less than 0.8 as long as, and usually greater in length than, the remainder of the rostrum. The spines on the dorsal and ventral surfaces of the merus of the cheliped (Figs. 1n, 2d–g) are strikingly more strongly developed than in any of the four species mentioned except in the “giant females” (unusually large individuals) of *Cambarellus chapalanus*. The ventral spine (never multiple except in *C. prolixus* and the giant females) is absent in most *C. montezumae*, in all *C. zempoalensis* that we have examined, and poorly developed in *C. patzcuarensis*, and the dorsal one is small to rudimentary in the latter three, and not much better developed in males and most females of *C. chapalanus*. The annulus ventralis of *C. prolixus* is proportionately broader than in the other four species mentioned, but that of *C. chapalanus* is more similar than are the strikingly more elongate ones of the remaining three. The mesial process of the first pleopod of *C. prolixus* is more robust than that of *C. zempoalensis* and not so far removed from the caudal process; also it is shorter than that of *C. montezumae*. Whereas *C. chapalanus* is known to occur in a number of localities in Jalisco and Michoacan, *C. prolixus* has been found only in Lago de Chapala.

Remarks.—*Cambarellus prolixus* is infested with the same entocytherid

ostracod, *Ankylocythere heterodonta* (Rioja, 1940), as are all of its relatives mentioned in the discussion of its relationships (see Hobbs, 1971:33).

Etymology.—*Prolixus* (L.), stretched out, long; so named because of the exceedingly long rostrum.

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